

Pipeline Group Factual Report

ATTACHMENT 27

Stork Laboratory Report- LA-MS state line to HA joints burst test

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Examination of Dixie Pipeline 12-inch Hydrostatic Test Failures
Louisiana/Mississippi State Line to Hattiesburg 34-570

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INTRODUCTION

During hydrostatic testing of Dixie Pipeline Company's 12-inch propane line from the Louisiana/Mississippi state line to Hattiesburg 34-370 there were seven hydrostatic test failures, three in Test Section 2A and four in Test Section 2B. The pipe was 12-3/4-inch O.D. x 0.250-inch wall, electric-resistance welded, API Specification 5LX Grade X52 manufactured by Lone Star Steel and installed in 1961. References to API requirements in this report refer to the Ninth Edition of API Specification 5LX, which was published in February, 1960, and was in force in 1961.

The APPENDIX of this report contains a "Pipeline Incident Background Data" sheet, provided by Dixie. For ease of reference, each rupture will be designated by the blowout number and test section, e.g., Pipe 1-2A for Blowout No. 1, Test Section 2A.

The ruptured pipes were sent to Stork Metallurgical Consultants, Inc. for examination to determine the cause of failure and the properties of the pipe.

SUMMARY OF FINDINGS

1. All of the pipes ruptured along the electric-resistance seam weld at either weld flaws or welds that were weak and brittle.
2. Of the seven ruptures, three were due to hook cracks, three were due to weak brittle welds caused by stitching, and one was due to a weak, brittle weld with no evidence of stitching. Stitching was also evident in two of the pipes with hook cracks.
3. One pipe had a distinct heat-affected zone (HAZ) from the electric-resistance weld, although all of the pipe should have been full-body normalized after welding. However, the apparent lack of post-weld heat treatment had no significant influence on the hardness.
4. All the pipes met the requirements of API Specification 5LX for wall thickness, outside diameter, chemical analysis and tensile properties for 12-inch Grade X52 pipe, except that the tensile strength of the weld of Pipe 1-2A could not be determined due to fracture of test coupons along the

weld during flattening. The fractured coupons showed stitching.

VISUAL AND METALLOGRAPHIC EXAMINATION

Most of the coating was intact on the outside surface of the pipe, and areas where the coating was missing showed no evidence of corrosion. The inside surface of the pipe was covered with a light rust layer, and there was no evidence of pitting or other significant corrosion.

All of the ruptures were in the electric-resistance seam weld, and two ruptures crossed a circumferential weld into an adjacent joint. Table 1 shows the location, failure pressure and length of each rupture referenced to the upstream circumferential weld.

The outside diameter (O.D.) and wall thickness were measured at one end of each pipe. The O.D. was measured with a pi tape, and the wall thickness was measured with a micrometer caliper every 45 degrees around the circumference, starting at the electric-resistance weld. The results, shown in Table 2, met API requirements. Note that on most of the pipes the wall thickness was either largest at the weld due to upsetting, or smallest due to flash trim.

Each pipe was photographed to document the appearance of the rupture, and the fracture surface on one side of the rupture was cleaned, examined visually and photographed. In each photograph the upstream end is at left, and a tape measure shows the distance from the upstream circumferential weld for reference. In some cases the fracture on one side of the rupture was torch cut from the pipe for examination and photography, and in some cases the fracture was examined and photographed without removing it from the pipe.

Several of the pipes showed mechanical damage at the outside surface, but in each case it was apparent that the damage occurred after the rupture, apparently during shipping and handling.

Small deposits of coating were found on some of the fracture surfaces. In some cases the deposits resulted from torch cutting of the pipe to remove one side of the fracture. In other cases the deposits were not near torch cuts, which indicates that either the pipe was cracked before it was coated, or that after the crack formed, the coating was heated high enough to allow some of it to flow into the crack.

Transverse sections were taken from each side of the fracture in each pipe at the most likely rupture origin, which generally was near the middle of the rupture. The specimens were polished and etched first with nital to show the microstructure, then with hot picric acid to show the flow lines. In the following photomicrographs the outside surface of the pipe is at top.

Pipe 1-2A

Pipe 1-2A had the longest rupture, 33 feet 3 inches. The fracture was flat and brittle for the full length with evidence of stitching on the outside surface, and what appeared to be dark oxides at the inside surface at several locations. Figure 1 shows part of the fracture, and Figure 2 is a close-up view of an area near the middle of the rupture with stitching and oxides.

We took matching transverse sections from each side of the fracture at 35 feet 10-1/2 inches for metallographic examination. Figures 3 and 4 show the sections after polishing and etching. There was a broad weld HAZ, indicative of a low frequency electric-resistance weld. As discussed later, the presence of the HAZ is unusual in Lone Star Steel pipe. The fracture was along the weld line and appeared brittle.

Pipe 2-2A

Figure 5 shows the rupture in 2-2A, which was 4 feet 4 inches long, with a bulge near the middle. There was a hook crack at the outside surface at the bulge, which was the apparent fracture origin. Figure 6 shows the fracture at the bulge with arrows indicating the hook crack. The dark material on the fracture is melted coating from torch cutting of the pipe.

Matching transverse sections were taken from each side of the fracture at the middle of the rupture at 2 feet 2 inches, and Figures 7 and 8 show the sections after polishing and etching. There was post-failure mechanical damage on each side of the fracture at the outside surface, and two large hook cracks were apparent, as indicated by the arrows in Figure 8.

Pipe 3-2A

Figure 9 shows the rupture in 3-2A, which was 12 feet long in one joint and crossed

a circumferential weld at the downstream end for a length of three inches. There were no chevron patterns or bulge to indicate the fracture origin, but there was evidence of stitching along the outside surface for much of the length of the fracture. Figure 10 shows an area near the middle of the rupture with stitching.

Matching transverse section were taken from each side of the fracture at 49 feet 2-1/2 inches for metallographic examination. Figures 11 and 12 show the sections after polishing and etching. The fracture was along the weld line, and there appeared to be a weld HAZ, although it was not as distinct as in Pipe 1-2A.

Pipe 1-2B

Pipe 1-2B ruptured for a length of four feet, with a bulge near the middle of the rupture, as shown in Figure 13. At the outside surface, there were small deposits of coating on the fracture and evidence of a hook crack at the middle of the bulge, as shown in figure 14.

We took matching transverse sections at 23 feet 5-1/2 inches for metallographic examination. As shown in Figures 15 and 16, there was a large hook crack at the outside surface, with fracture along the weld line below the hook crack.

Pipe 2-2B

The rupture in 2-2B, shown in Figure 17, was 5 feet 6 inches long and appeared similar to the rupture in 1-2B except that there was no coating on the fracture surface. There were no chevrons, nor indications of hook cracks or oxides. There was evidence of stitching, and the fracture at the middle of the bulge was very flat and brittle, as shown in Figure 18.

We took matching sections from the middle of the bulge at 35 feet 1/2 inch, which are shown in Figures 19 and 20 after polishing and etching. The fracture was along the weld line, and there was mechanical damage at the outside surface on one side of the fracture. There was a slight mismatch of the skelp edges (high-low), as indicated by the un-trimmed flash at right.

Pipe 3-2B

Pipe 3-2B ruptured for a length of 4 feet, with a bulge in the middle, and no other

indication of the fracture origin. Figure 21 shows the ruptured pipe, and Figure 22 is a close-up view of the fracture at the rupture. The fracture surface appeared brittle, but there was no evidence of stitching or oxides.

Matching sections were taken from the middle of the rupture at 35 feet 1 inch, and are shown in Figures 23 and 24 after polishing and etching. The fracture was along the weld line, and there was mechanical damage at the outside surface.

Pipe 4-2B

Pipe 4-2B, shown in Figure 25, ruptured for a length of 4 feet, with a bulge in the middle, and evidence of coating and weld flaws at the middle of the bulge. Figure 26 is a close-up view of the fracture at the bulge with arrows indicating the coating and flaws.

Matching sections were taken from the flaw at 25 feet 2-1/2 inches, indicated by the arrow at right in Figure 26, and are shown after polishing and etching in Figures 27 and 28. There was a large hook crack at the outside surface, and most of the fracture below the hook crack was along the weld line.

HARDNESS TESTS

Hardness surveys using a Vickers indenter and a 10-kgf load (HV 10) were made on the sections from Pipe 1-2A, shown in Figures 3 and 4, which had a distinct HAZ; and on the sections from Pipe 4-2B, which had no HAZ, for comparison. Four indentations spaced equally across the wall thickness starting 0.020 inch from the outside surface were made at three locations on each side of the fracture: in the base metal (BM) beyond the HAZ, in the middle of the HAZ, and as close as possible to the weld line (Weld). As shown in Table 3, there was no significant difference in the hardness of the two pipes.

CHEMICAL ANALYSES

The chemical composition of each pipe was determined by optical emission spectroscopy, except for the carbon content, which was determined by the combustion infrared method. As shown in Table 4, all the pipe met the API

requirements for Grade X52, and had similar compositions.

TENSION TESTS

Transverse specimens were taken from the base metal and across the weld, and tested in accordance with API requirements. As shown in Table 5, all the pipe met the requirements for Grade X52, except that the weld of Pipe 1-2A could not be tested. Two coupons from which tension-test specimens were to be machined fractured along the weld during flattening prior to machining. Examination of the fracture surfaces showed stitching.

CHARPY IMPACT TESTS

One set of three 1/2-size (10-mm x 5-mm) Charpy V-notch impact specimens was machined from the base metal and weld of each pipe and tested at 70°F, with the results shown in Table 6. Except for Pipe 3-2B, the impact properties of the welds were much lower than those of the base metal. The lowest impact properties were in the weld of Pipe 1-2A, which fractured during flattening of the tension-test coupons.

DISCUSSION

All the failures were due to weld conditions often found in low-frequency electric-resistance welded pipe manufactured in the 1960s. Three of the failures initiated at hook cracks, which are separations that form along the up-turned and/or down-turned fiber lines adjacent to the weld. As the abutting skelp edges are forced together during welding, the fiber lines are bent toward the outside and inside surfaces, forming planes of weakness parallel to the weld. Depending on a number of variables, particularly the degree of segregation and the number and size of inclusions along the fiber lines, shear stresses during welding may cause hook cracks, or they may subsequently form from hoop stress caused by internal pressure.

Three of the failures were due to stitching, which results from too high a production speed for the welding frequency. Alternating current produces two peaks per cycle

at which the current, and consequently the heat, is at a maximum. Midway between each peak the current is zero. If the production speed is too high for the current frequency, the peak heat is insufficient to cause enough heat flow by conduction to the areas that see zero current, resulting in a “cold” weld that is weak and brittle. Two of the pipes with hook cracks also exhibited stitching.

One failure, in Pipe 3-2B showed no stitching, but the weld was flat and brittle, and also appeared to be a cold weld. In addition to stitching, cold welds result from any variation in welding conditions that cause insufficient heat or pressure to make a sound weld.

Pipe 1-2A showed a clear HAZ, which is unexpected because Lone Star Steel has always full-body normalized electric-resistance welded pipe, which normally obliterates the weld HAZ. Many manufacturers did not post-weld heat treat electric-resistance welded pipe in the 1960s, and we considered the possibility that Pipe 1-2A was from another manufacturer. However, the chemical composition of Pipe 1-2A was very similar to the others. Of particular significance is the relatively high content of copper, and to a lesser extent chromium and nickel, for Grade X52 pipe, which indicates the pipe was made from electric-furnace steel with a high scrap content. Lone Star Steel was one of the few domestic manufacturers to use electric-furnace steel for line pipe in the 1960s. Pipe 3-2A also appeared to have a weld HAZ, although it was not as distinct as in Pipe 1-2A. The similarity of chemical compositions and appearance of a HAZ in two pipes suggests a malfunction in the post-weld heat treatment such that Pipe 1-2A was subjected to little or no heat, and Pipe 3-2A was heated, but not sufficiently to obliterate the weld HAZ.

All the pipe met the API requirements for chemical composition and tensile properties, except for the weld tensile strength of Pipe 1-2A, which could not be determined.

Sincerely,



T. V. Bruno
Senior Consultant

TVB:kw



Figure 1

Photograph of part of the rupture in Pipe 1-2A, showing the flat brittle fracture.



Figure 2

Close-up view showing evidence of stitching at the outside surface, and dark oxides along the inside surface of Pipe 1-2A.

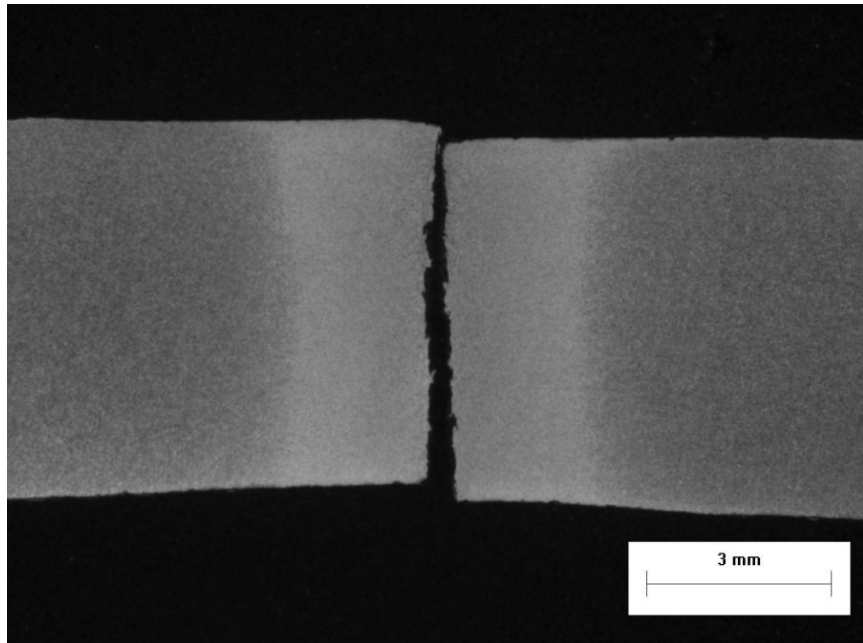


Figure 3

8X
Nital Etch

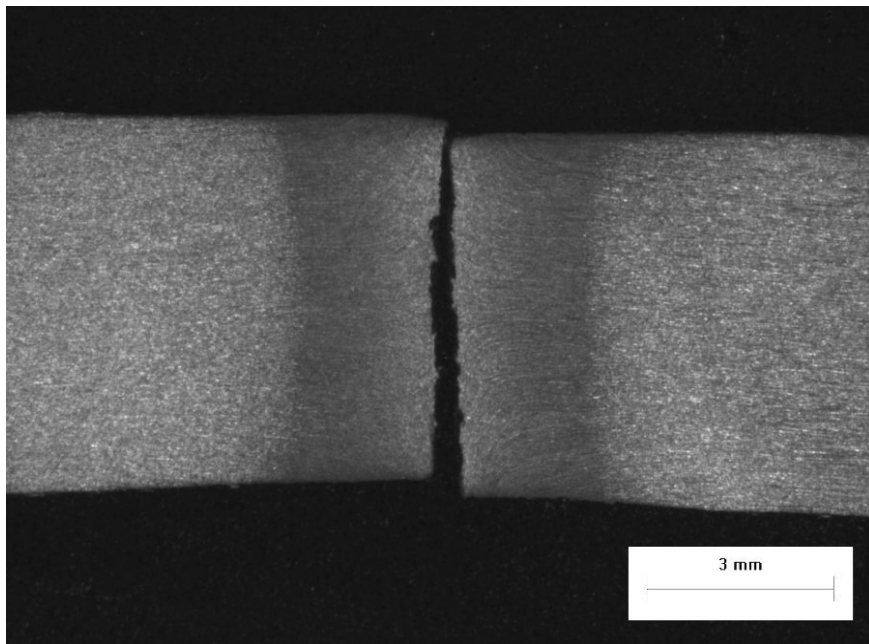


Figure 4

8X
Hot Picric Acid Etch

Photomicrographs of the sections from Pipe 1-2A. Note the weld HAZ.

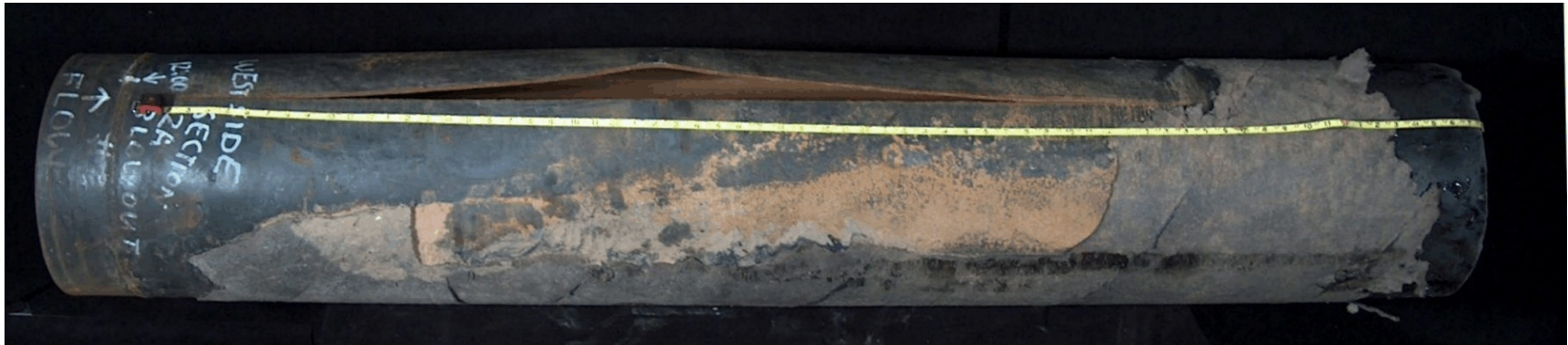


Figure 5

Photograph of Pipe 2-2A.



Figure 6

Close-up view of the apparent fracture origin, with arrows indicating a hook crack in Pipe2-2A.

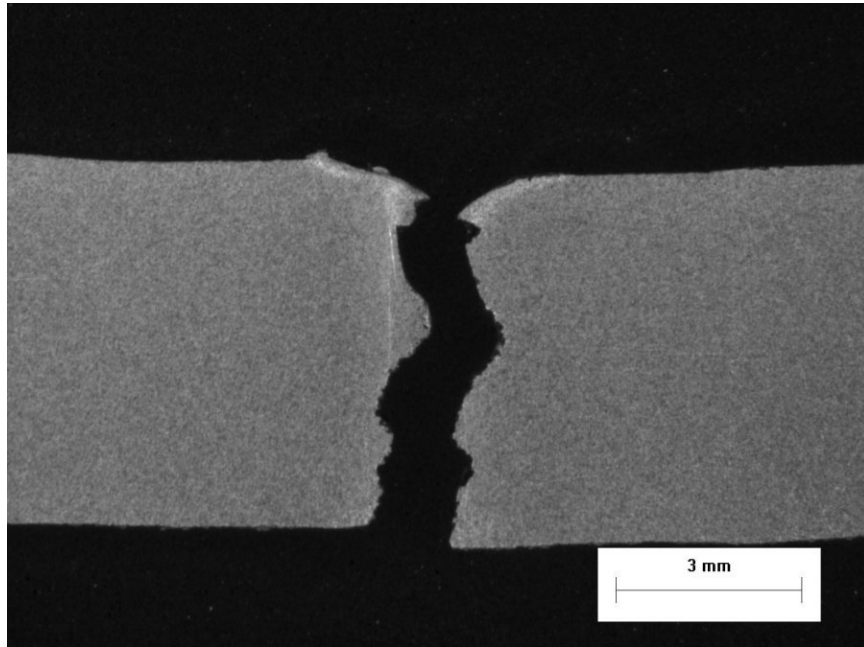


Figure 7

8X
Nital Etch

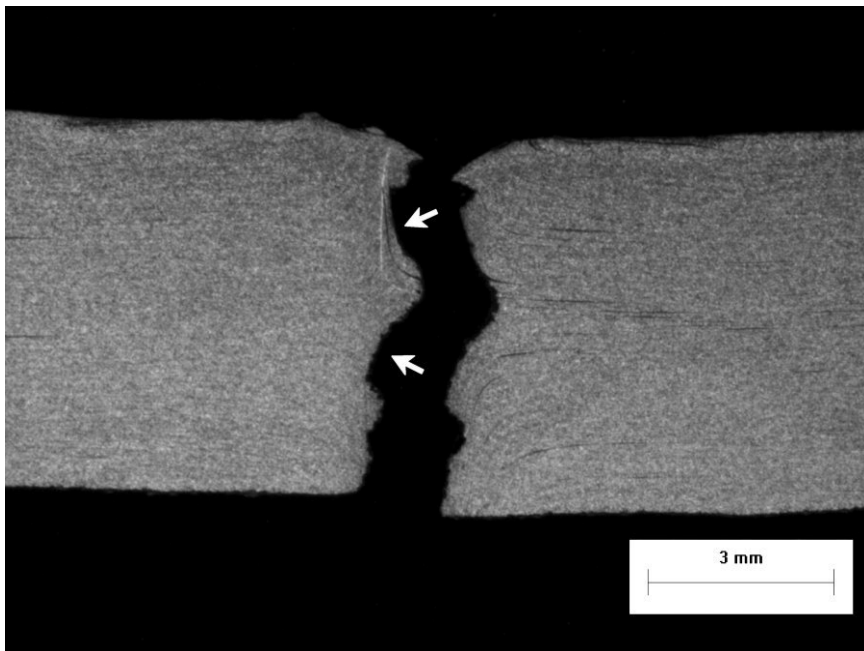


Figure 8

8X
Hot Picric Acid Etch

Photomicrographs of the sections from Pipe 2-2A, showing hook cracks, arrows, The outside surface was damaged after the rupture.



Figure 9

Photograph of the rupture in 3-2A, which crossed the circumferential weld at the downstream end.



Figure 10

Close-up view at the middle of the rupture in Pipe 3-2A showing flat fracture with stitching along the outside surface.

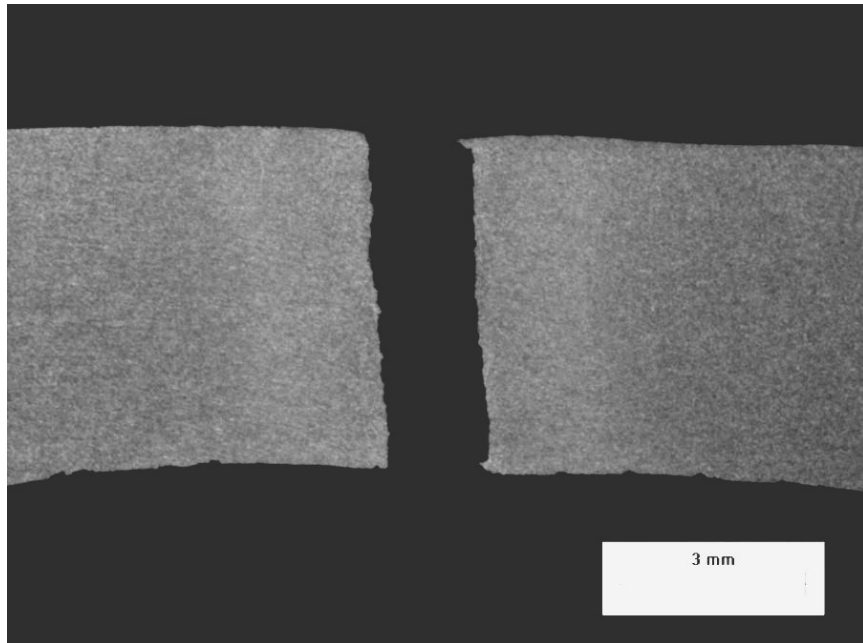


Figure 11

8X
Nital Etch

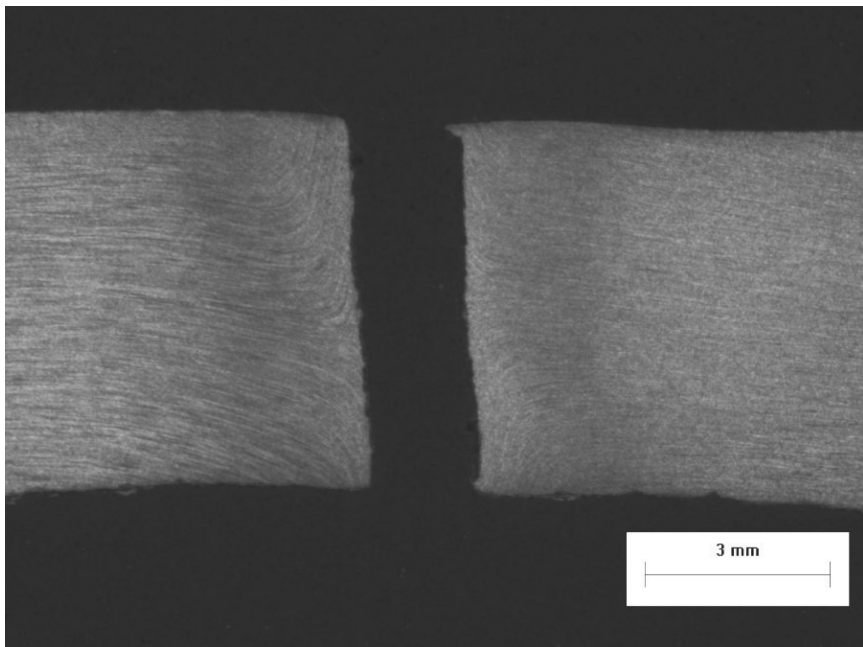


Figure 12

8X
Hot Picric Acid Etch

Photomicrographs of the sections from Pipe 3-2A, showing fracture along the weld line.



Figure 13

Photograph of Pipe 1-2B.



Figure 14

Close-up view of the bulge showing coating on the fracture at the outside surface of Pipe 1-2B.

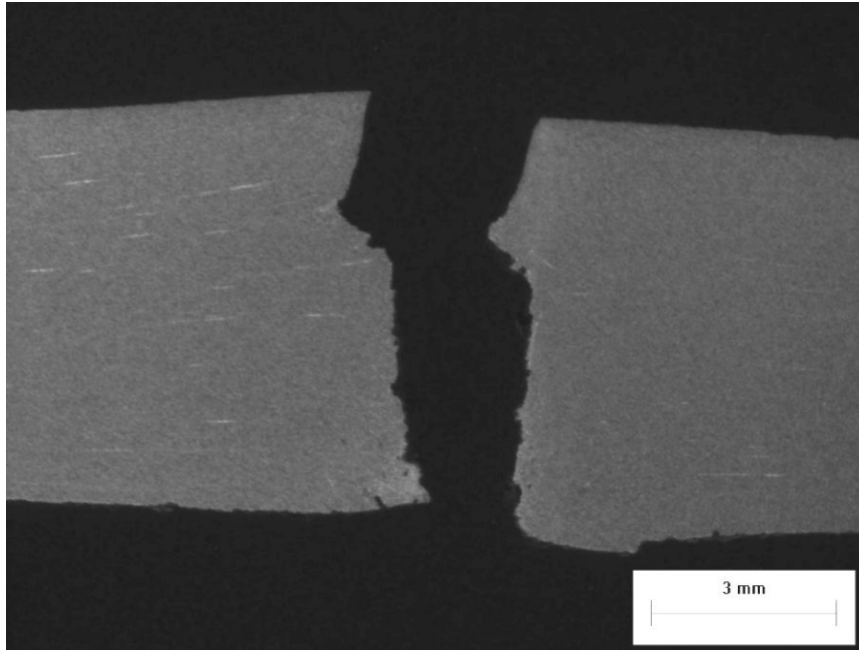


Figure 15

8X

Nital Etch

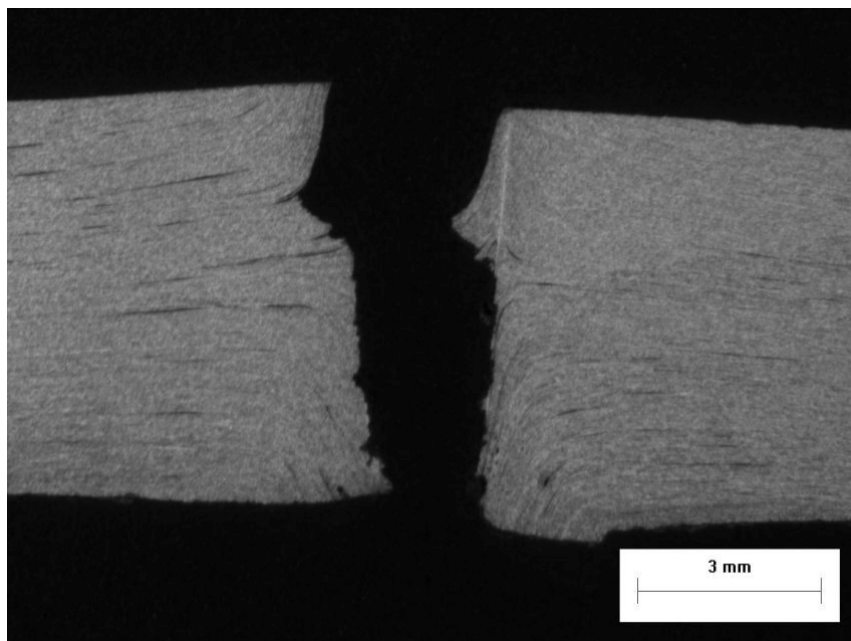


Figure 16

8X

Hot Picric Acid Etch

Photomicrographs of the sections from Pipe 1-2B, showing a large hook crack at the outside surface.



Figure 17

Photograph of Pipe 2-2B.

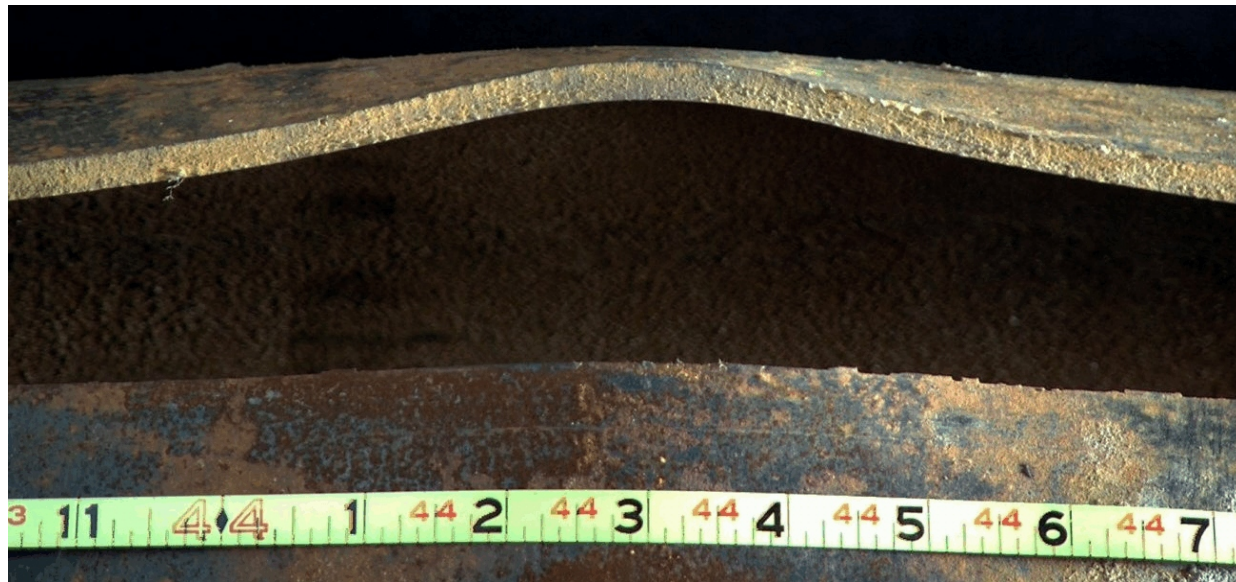


Figure 18

Close-up view showing the fracture at the middle of the bulge in Pipe 2-2B.

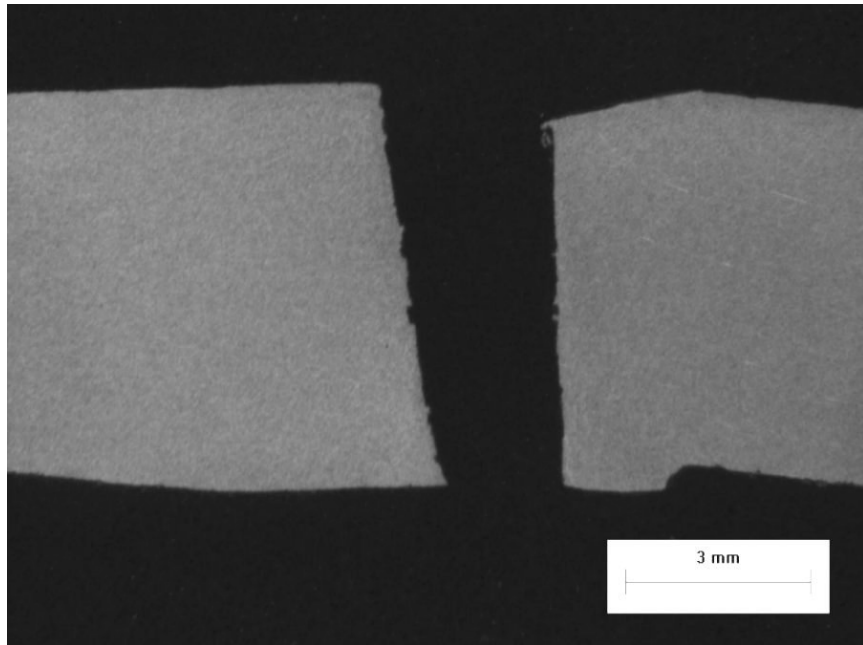


Figure 19

8X
Nital Etch

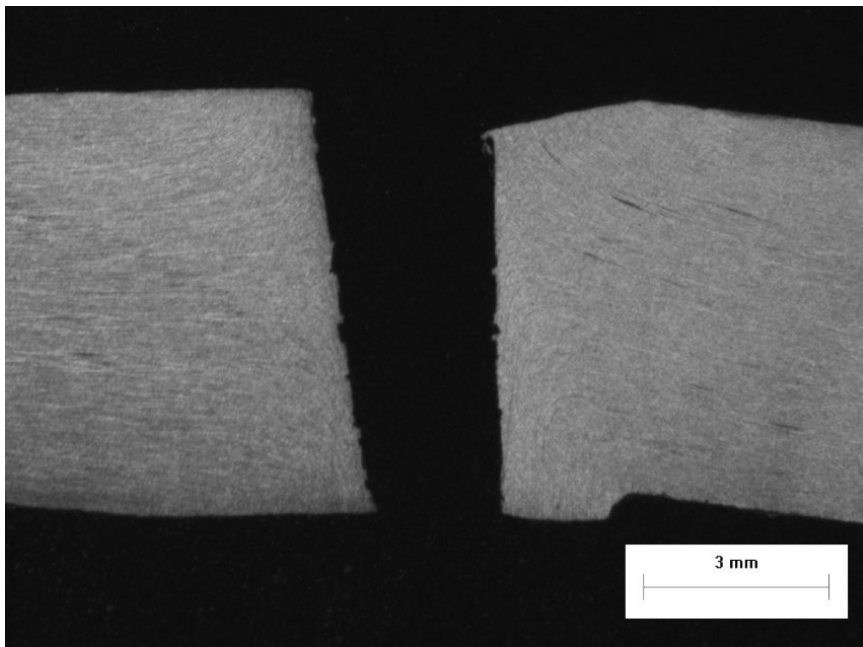


Figure 20

8X
Hot Picric Acid Etch

Photomicrographs of the sections from Pipe 2-2B, showing fracture along the weld line, and post-failure mechanical damage at the outside surface at right.



Figure 21

Photograph of Pipe 3-2B.



Figure 22

Close-up view showing the fracture at the middle of the bulge in Pipe 3-2B.

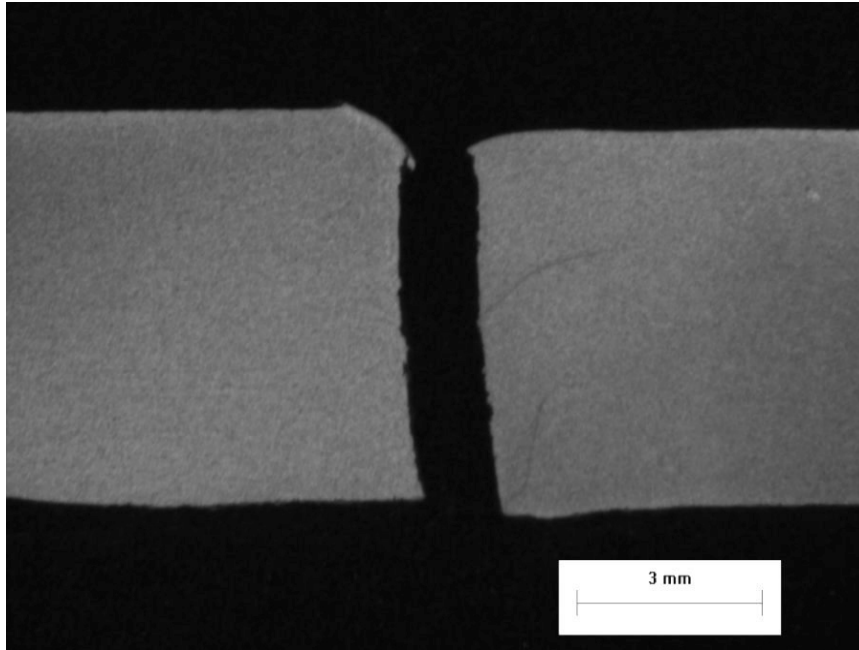


Figure 23

8X
Nital Etch

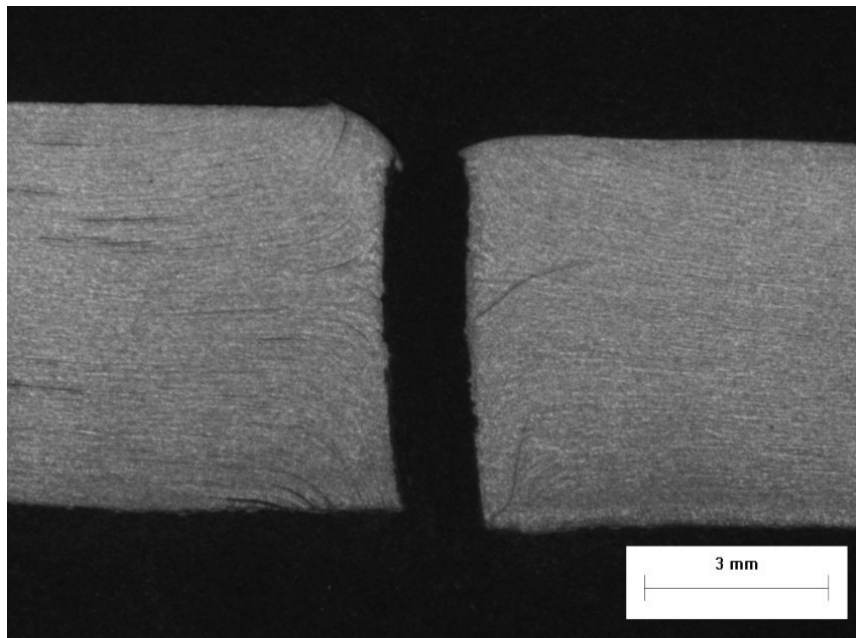


Figure 24

8X
Hot Picric Acid Etch

Photomicrographs of the section from Pipe 3-2B, showing fracture along the weld line, and post-failure mechanical damage at the outside surface at left.



Figure 25

Photograph of Pipe 4-2B.



Figure 26

Close-up view showing small spots of coating, red arrows, and apparent weld flaws, white arrows along the fracture.

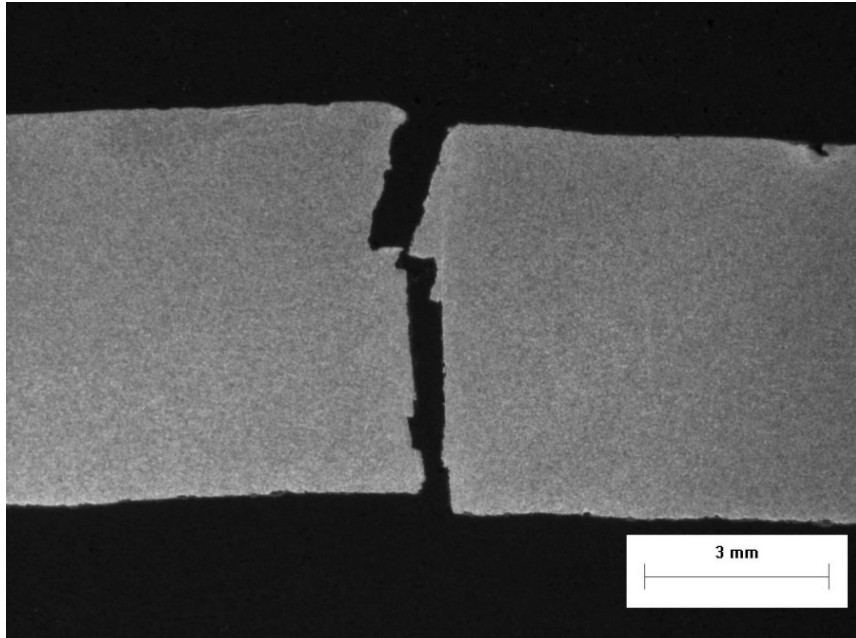


Figure 27

8X
Nital Etch

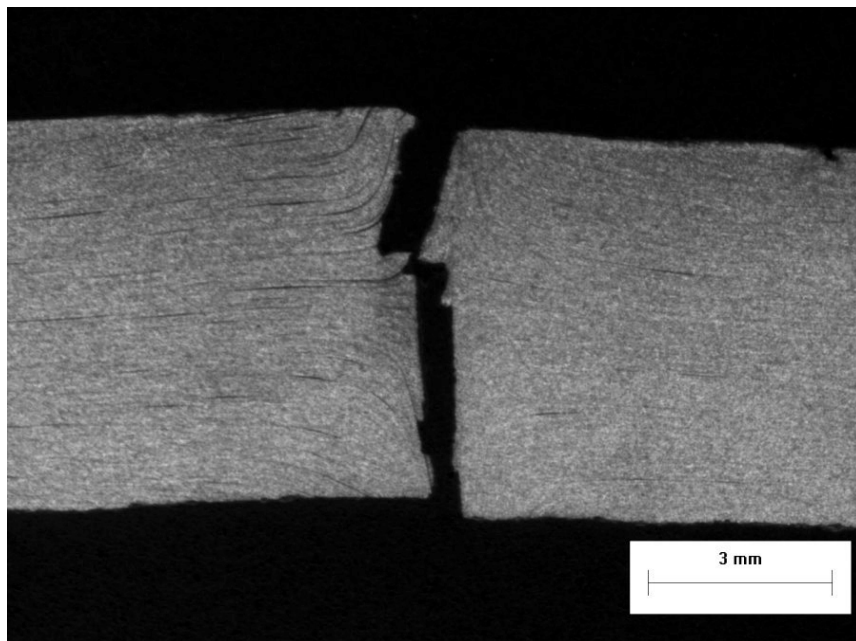


Figure 28

8X
Hot Picric Acid Etch

Photomicrographs of the sections from Pipe 4-2B, showing a large hook crack at the outside surface.

Rupture	Location, Mile Post	Pressure, psi	Fracture Length	Distance from Upstream Weld
1-2A	327.48	1960	30' first joint 3" second joint	23' first joint
2-2A	318.87	1903	4'4"	0
3-2A	326.00	1921	12' first joint 3" second joint	41' first joint
1-2B	351.68	1895	4'	22'
2-2B	351.59	1904	5'6"	42'
3-2B	364.48	1922	4'	31'
4-2B	365.81	1929	4'	24'

Table 1

Summary of data from each rupture.

Rupture	Dimensions, in.		
	O.D.	Wall Thickness	
1-2A	12.77	0.244 0.251 0.251 0.248	0.254 0.251 0.253 0.250
2-2A	12.77	0.251 0.250 0.250 0.249	0.248 0.249 0.248 0.250
3-2A	12.78	0.241 0.253 0.253 0.256	0.254 0.253 0.253 0.253
1-2B	12.72	0.275 0.251 0.250 0.251	0.251 0.251 0.251 0.250
2-2B	12.76	0.280 0.249 0.250 0.251	0.250 0.252 0.250 0.251
3-2B	12.76	0.268 0.248 0.248 0.250	0.250 0.250 0.250 0.249
4-2B	12.77	0.256 0.249 0.247 0.248	.0247 0.248 0.248 0.248
API	12.75± 1% 12.62 Min. 12.88 Max.	0.250 -12.5,+15% 0.212 Min. 0.288 Max.	

Table 2

Results of the O.D. and wall thickness measurements.

Hardness, HV 10						
	<u>BM</u>	<u>HAZ</u>	<u>Weld</u>	<u>Weld</u>	<u>HAZ</u>	<u>BM</u>
Pipe 1-2A:	193	208	206	203	208	202
	193	198	199	198	198	197
	193	202	200	198	200	191
	197	202	198	193	201	195
Average:	194	203	201	198	202	196
Pipe 4-2B:	190	194	191	189	200	194
	191	201	201	197	199	193
	198	201	199	198	202	199
	199	207	201	201	201	200
Average:	195	202	198	196	201	197

Table 3

Results of the hardness tests.

	<u>Chemical Analyses</u>							
	<u>1-2A</u>	<u>2-2A</u>	<u>3-2A</u>	<u>1-2B</u>	<u>2-2B</u>	<u>3-2B</u>	<u>4-2B</u>	<u>Grade X52</u>
Carbon, %	0.25	0.26	0.25	0.28	0.23	0.25	0.25	0.35 max.
Manganese, %	1.18	1.31	1.25	1.21	1.25	1.19	1.18	1.40 max.
Phosphorus, %	0.036	0.031	0.037	0.028	0.030	0.029	0.033	0.05 max.
Sulfur, %	0.024	0.027	0.026	0.026	0.027	0.035	0.027	0.06 max.
Silicon, %	0.04	0.03	0.04	0.04	0.04	0.05	0.06	*
Chromium, %	0.04	0.03	0.05	0.06	0.04	0.03	0.02	*
Nickel, %	0.07	0.10	0.10	0.12	0.10	0.08	0.07	*
Molybdenum, %	0.01	0.01	0.01	0.01	0.01	0.01	0.01	*
Copper, %	0.44	0.37	0.45	0.51	0.41	0.41	0.41	*

*Not Specified

Table 4

Results of the chemical analysis.

		<u>Tension Tests</u>						
<u>Pipe Body</u>	<u>1-2A</u>	<u>2-2A</u>	<u>3-2A</u>	<u>1-2B</u>	<u>2-2B</u>	<u>3-2B</u>	<u>4-2B</u>	<u>Grade X52</u>
Yield Strength*, ksi	62.3	58.5	60.4	60.6	56.9	60.3	63.0	52.0 Min.
Tensile Strength, ksi	83.1	84.4	85.0	87.9	82.8	84.8	89.0	66.0 Min.
Elongation, % in 2"	24.1	31.4	21.9	28.0	28.2	30.7	25.8	22.0 Min.
<u>Weld</u>								
Tensile Strength, ksi	**	84.3	73.1	83.5	77.4	80.6	79.1	66.0 Min.

*At 0.05% total extension

**Two specimens fractured during flattening

Table 5

Results of the tension tests.

<u>Charpy V-Notch Impact Tests*</u>							
<u>Pipe Body</u>	<u>1-2A</u>	<u>2-2A</u>	<u>3-2A</u>	<u>1-2B</u>	<u>2-2B</u>	<u>3-2B</u>	<u>4-2B</u>
Energy, ft-lbs	10, 11, 10.5	13, 14, 14	11, 11, 12.5	12, 12.5, 12.5	12, 12, 12	12, 12, 12	13, 13, 14.5
Percent Shear	95, 95, 95	95, 95, 95	90, 90, 90	95, 95, 95	100, 100, 100	100, 100, 100	80, 80, 80
<u>Weld</u>							
Energy, ft-lbs	1.5, 2, 5	7, 5, 5	7, 4, 5	5, 5.5, 9	6, 7.5, 7.5	14, 14, 7	3.5, 13.5, 4
Percent Shear	10, 10, 5	5, 5, 5	5, 5, 5	5, 30, 95	5, 5, 5	100, 100, 5	5, 5, 5
*1/2-size transverse specimens tested at 70°F							

Table 6

Results of the impact tests.

APPENDIX

Pipeline Incident Background Data

Provided By

Dixie Pipeline Company

BlowOut #1 Section 2A

PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 17290+92 MP327.48
5. Date of Failure/Incident/Anomaly: 5-30-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Marion County (Foxworth) Mississippi
8. Pipe nominal outside diameter: 12.750
9. Pipe nominal wall thickness: .250
10. Pipe grade: X52
11. Pipe seam type and joint length: ERW 2 Joints 53' & 60'
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 7.84 Miles Downstream
17. Terrain and soil conditions: Pasture (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream: 25.99 Mile (Mt. Hermon) Downstream: 18.43 (Oloh)
19. Distance to upstream and downstream girth welds:
Upstream: 23' (First Joint) Downstream: 59'9" (Second Joint)
20. Position of failure or anomaly on pipe circumference: 05:00 (First Joint) 11:00 (Second Joint)
21. Pressure at time and location of failure/incident/anomaly: (1960psi) @09:18 MP 327.48
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly: (1960psi) @MP327.48
26. Other comments and/or observations:
27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952

BlowOut #2 Section 2A

PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 16836+58 MP318.87
5. Date of Failure/Incident/Anomaly 6-2-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Walthall County (Dexter) Mississippi
8. Pipe nominal outside diameter:12.750
9. Pipe nominal wall thickness:.250
10. Pipe grade:X52
11. Pipe seam type and joint length: ERW 59'10"
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 16.45 Miles Downstream
17. Terrain and soil conditions: Timber (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream:17.38 Miles (Mt. Hermon) Downstream: 27.04 (Oloh)
19. Distance to upstream and downstream girth welds:
Upstream: 0 Downstream: 55'6"
20. Position of failure or anomaly on pipe circumference: 01:00
21. Pressure at time and location of failure/incident/anomaly: 1903 psi @08:48 MP 318.87
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly:
26. Other comments and/or observations:

27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952

BlowOut #3 Section 2A

PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 17212+79 MP 326.00
5. Date of Failure/Incident/Anomaly 6-4-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Marion County (Foxworth) Mississippi
8. Pipe nominal outside diameter: 12.750
9. Pipe nominal wall thickness: .250
10. Pipe grade: X52
11. Pipe seam type and joint length: ERW First Joint 53'0" Second Joint 52'8"
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 9.32 Miles Downstream
17. Terrain and soil conditions: Pasture (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream: 24.51 Miles (Mt. Hermon) Downstream: 19.91 Miles (Oloh)
19. Distance to upstream and downstream girth welds:
Upstream: 41' of First Joint Downstream: 52'5" of Second Joint
20. Position of failure or anomaly on pipe circumference: 09:00 First Joint & 11:00 Second Joint
21. Pressure at time and location of failure/incident/anomaly: 1912 psi @ 08:57 MP 326.00
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly:
26. Other comments and/or observations:

27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952

BlowOut #1 Section 2B
PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 18568+81 MP 351.68
5. Date of Failure/Incident/Anomaly 6-1-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Lamar County (Hattiesburg) Mississippi
8. Pipe nominal outside diameter: 12.750
9. Pipe nominal wall thickness: .250
10. Pipe grade: X52
11. Pipe seam type and joint length: ERW 58'
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 5.68 Miles Upstream
17. Terrain and soil conditions: Timber (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream: 5.77 Miles (Oloh) Downstream: 15.71 Miles (Hattiesburg)
19. Distance to upstream and downstream girth welds:
Upstream: 22' Downstream: 32'
20. Position of failure or anomaly on pipe circumference: 10:00
21. Pressure at time and location of failure/incident/anomaly: 1895 psi @ 12:30 MP 351.68
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly:
26. Other comments and/or observations:

27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952

BlowOut #2 Section 2B

PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 18563+84 MP 351.59
5. Date of Failure/Incident/Anomaly 6-3-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Lamar County (Hattiesburg) Mississippi
8. Pipe nominal outside diameter: 12.750
9. Pipe nominal wall thickness: .250
10. Pipe grade: X52
11. Pipe seam type and joint length: ERW 53'
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 2.91 Miles Downstream
17. Terrain and soil conditions: Timber (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream: 5.68 Miles (Oloh) Downstream: 15.80 Miles (Hattiesburg)
19. Distance to upstream and downstream girth welds:
Upstream: 42' Downstream: 5'6"
20. Position of failure or anomaly on pipe circumference: 06:00
21. Pressure at time and location of failure/incident/anomaly: 1904 psi @ 08:08 MP 351.59
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly:
26. Other comments and/or observations:
27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952

BlowOut #3 Section 2B

PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 19244+38 MP 364.48
5. Date of Failure/Incident/Anomaly 6-5-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Forrest County (Hattiesburg) Mississippi
8. Pipe nominal outside diameter: 12.750
9. Pipe nominal wall thickness: .250
10. Pipe grade: X52
11. Pipe seam type and joint length: ERW 59'
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 2.91 Miles Downstream
17. Terrain and soil conditions: Residential (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream: 18.57 Miles (Oloh) Downstream: 2.91 Miles (Hattiesburg)
19. Distance to upstream and downstream girth welds:
Upstream: 31' Downstream: 24'
20. Position of failure or anomaly on pipe circumference: 03:00
21. Pressure at time and location of failure/incident/anomaly: 1922 psi @ 08:31 MP 364.48
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly:
26. Other comments and/or observations:

27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952

BlowOut #4 Section 2B
PIPELINE INCIDENT BACKGROUND DATA

Please provide the following data to the best of your available information. Not all data fields will be applicable to your system or may be known.

1. Operating Company: Dixie Pipeline Company
2. Product: Propane
3. Line Name and Number and/or System Name: LA./ MS. State Line to Hattiesburg 34-570
4. Survey Station and Mile Post: 19314+39 MP 365.81
5. Date of Failure/Incident/Anomaly 6-7-2007
6. How was the Failure/Incident/Anomaly found: Hydrotest (Seam Failure)
7. State, county, and closest city or town: Forrest County (Hattiesburg) Mississippi
8. Pipe nominal outside diameter: 12.750
9. Pipe nominal wall thickness: .250
10. Pipe grade: X52
11. Pipe seam type and joint length: ERW 60'
12. Pipe manufacturer: Lone Star
13. Year of installation: 1961
14. Coating type: Coal Tar Enamel & Felt Wrap
15. Cathodic protection type and year installed:
16. Distance to nearest rectifier or anode bed: 1.58 Miles Downstream
17. Terrain and soil conditions: Timber (Loam)
18. Distance to upstream and downstream compressor or pumping stations:
Upstream: 19.90 Miles (Oloh) Downstream: 1.58 Miles (Hattiesburg)
19. Distance to upstream and downstream girth welds:
Upstream: 24' Downstream: 32'
20. Position of failure or anomaly on pipe circumference: 01:00
21. Pressure at time and location of failure/incident/anomaly: 1929 psi @ 11:10 MP 365.81
22. Normal operating pressure at location of failure/incident/anomaly: Various
23. MOP, MAOP, Design Factor, and/or Location Class:
24. Date, Test Pressure, and Duration of most recent hydrostatic test:
25. Hydrostatic test pressure at location of failure/incident/anomaly:
26. Other comments and/or observations:

27. Contact information if we need further information: Jake L. Sullivan 601-545-3714 or 601-297-7952